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LANDSAT 7 (L7) ENHANCED THEMATIC MAPPER PLUS (ETM+) DATA VALIDATION AND EXCHANGE IMPLEMENTATION PLAN

Version 1.0

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USGS
science for a changing world

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Executive Summary

This Landsat 7 (L7) Data Validation and Exchange (DV&E) Implementation Plan provides the U.S. Geological Survey (USGS) and the International Cooperators (ICs) with a reference document to assist in the validation and exchange of L7 image data.

This document is under the control of the Landsat Configuration Control Board (LCCB). Landsat Configuration Change Requests (LCCRs) related to this document, as well as supportive material justifying the proposed changes, should be submitted to the Mission Management Office (MMO) at the USGS Center for Earth Resources Observation and Science (EROS) in Sioux Falls, South Dakota.

Document Change Summary

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L7-PD-52	Version 1.0	April 2006	LCCR 268

Contents

Section 1 Introduction

1.1 Purpose and Scope

This Data Validation and Exchange (DV&E) Implementation Plan defines the conditions and procedures used to validate the interchangeability and comparable quality of Landsat 7 Raw Computer Compatible (RCC) and Level Zero Reformatted Distribution Product (L0Rp) data. It also describes the conditions and procedures used to implement the Data Exchange Annex of the Memorandum of Understanding (MOU) between the United States Geological Survey (USGS) and the International Cooperator (IC).

This document does not address the conditions, procedures, and criteria to be used for producers of Level 1 products who are seeking to have their processing systems validated by the USGS. These topics are addressed in the Level 1 Validation Product Content and Format Specification (L7-PD-15) and Level 1G (L1G) Product Evaluation Criteria (L7-PD-10).

This document is intended to supplement Annex III to the Memorandum of Understanding between the United States Geological Survey (USGS) and the International Cooperator (IC) Landsat 7 Data Exchange. The signed Annex III is the authoritative source of information relating to data exchange between the USGS and the IC, and in any discrepancies between the two documents Annex III shall take precedence.

1.2 Overview and Background

Bilateral data quality validation and exchange is established under the provisions of the MOU that exists between the USGS and each of the ICs. While the IC represents the signatory organization, each IC may operate one or more individual International Ground Stations (IGSs). The IGS is the entity that is responsible for receiving direct X-band downlink data from the L7 satellite and interacting with the USGS for the data validation activities.

The reason for inter-station data format and quality validation of RCC and L0Rp products generated by the USGS and the ICs is to ensure archive compatibility in the case data exchange is required.

The reasons for data exchange are to provide data for:

- Product validation
- Key government programs
- Significant loss of the L7 spacecraft capability
- Short-term loss of IC reception capability

1.3 Goals and Objectives

The goals and objectives of the DV&E Implementation Plan are as follows:

- Describe the procedures used to validate that the approved data exchange formats (RCC and L0Rp) are interchangeable and generated according to the appropriate Data Format Control Book (DFCB) and product specifications.
- Define a data exchange procedure for key government programs, of either a U.S. or IC agency, to acquire L7 data from a station's archive in support of scientific research or disaster response.
- Define a procedure for acquiring IGS L7 data in the event of a spacecraft anomaly that prevents use of the Solid State Recorder (SSR) or other downlink subsystem(s).
- Define a procedure for ICs to obtain data from the U.S. archive in the event of a short-term loss of direct data reception capability.

1.4 Expiration

Policies and terms in this plan will expire upon termination of the L7 MOU between the USGS and the IC.

Section 2 Product Validation

2.1 Definition

Data quality validation consists of a comparison between the USGS RCC data and/or L0Rp products generated by an IGS (operated by an L7 IC), in order to verify compliance with the appropriate DFCB and product specifications such as media and format requirements.

Data exchanged for quality validation purposes refers to transfers from an IGS to the USGS and transfers from the USGS to an IGS.

2.2 Data Requirements

As specified in the USGS/IC MOU, Section II.B.11, each IGS operated by an IC will be asked twice each year to provide RCC data and/or L0Rp products to the USGS for validation purposes. Each IGS will establish and maintain a single point-of-contact (POC) who serves as the primary interface for communications with the USGS POC regarding all data quality validation activities. The USGS will specify the path, row, acquisition date, and IGS orbit number of the data required for validation.

The specific type of data that will be required for the IGS data validation exercise is specified in the individual MOU that exists between the USGS and the IC that operates that IGS. RCC data will be requested by contact/subinterval number and/or time index. L0Rp products will be requested by path/row and acquisition date.

RCC data are to be delivered as subinterval data written to a single media in accordance with the L7 RCC DFCB (LS-DFCB-01). L0Rp data are to be delivered as a one-scene product in Hierarchical Data Format (HDF), written to a single media in accordance with the L7 L0Rp DFCB (LS-DFCB-03). If electronic transfer will be used, the USGS may request that the data be provided via File Transfer Protocol (FTP) push by the IGS to a specified USGS FTP location.

Revalidation for each IGS will occur on a biannual basis after the USGS has been able to extract, ingest, and process RCC and/or L0Rp data from that IGS.

2.3 Validation Activity Overview

For L7 validation, image data captured via direct downlink to the IGS will be compared with corresponding SSR image data received at a USGS ground station.

2.3.1 RCC Data Validation

Ground stations providing RCC data for validation purposes will copy the L7 RCC data to one of the required media in accordance with the L7 RCC DFCB (LS-DFCB-01) and ship to the USGS along with all supplementary information. Upon arrival at the USGS, the IGS RCC data will be extracted, ingested, processed to L0Rp, and compared to the equivalent L0Rp data that were received from SSR and processed by the USGS. Both the USGS and IGS L0Rp data will then be processed to a Level 1 Geometrically

Corrected (L1G) product, and will again be compared in order to validate that the L1G data products are of equivalent quality.

2.3.2 L0Rp Data Validation

Ground stations providing L0Rp data will write a single-scene L0Rp product in HDF to the required media in accordance with the L7 L0Rp DFCB (LS-DFCB-03) and ship to the USGS along with all supplementary information. Upon arrival at the USGS, the IGS L0Rp image data will be ingested and compared to L0Rp DFCB (LS-DFCB-03) and the equivalent L0Rp image data that were received from SSR and processed by the USGS. Both the USGS and IGS L0Rp data will then be processed to a Level 1 Geometrically Corrected (L1G) product, and will again be compared in order to validate that the L1G data products are of equivalent quality.

2.4 Supplementary Information

Supplementary information is required for success of the data quality validation exercise. Each IGS shall include this documentation with all validation data sent to the USGS. The specific information that is required by the USGS includes: path, row(s), acquisition date/time, ground station identification, contact start/stop times, and the method used to write data to the media (e.g., block size, tar).

2.5 Media and Format Requirements

Each IGS shall provide RCC and/or L0Rp data in accordance with the media and formats described in the L7 RCC DFCB (LS-DFCB-01) and/or L7 L0Rp DFCB (LS-DFCB-03).

Hardcopy documentation of the data contents is required for all physical media transferred to and from the USGS (described in Section 2.4). Softcopy documentation of the data contents is required for all electronic media transferred to and from the USGS (described in Section 2.4).

2.6 Data Delivery Requirements

In order to ensure a timely completion of the validation procedures, a two-week turn-around time is required from receipt of the validation data request at the IGS to the delivery of the RCC data and/or L0Rp products at the USGS. The IGS will be responsible for placing orders and addressing any logistical issues related to fulfillment of the USGS data request.

2.7 Scheduling and Frequency

Each IGS is scheduled to provide validation data to the USGS twice per year. Similarly, an IGS may request validation data from the USGS once per year. Additional data sets may be provided upon request, with the approval of the Landsat Project Manager.

2.8 USGS Validation Procedures

2.8.1 Raw Computer Compatible (RCC) Data

The objectives of the RCC data validation procedures include:

- Verifying that the IGS RCC data are of equivalent quality to those generated by the USGS.
- Verifying conformance to the L7 RCC DFCB (LS-DFCB-01) specifications, thus ensuring that RCC data provided by multiple stations is readable using standard ingest routines.
- Verifying that the RCC data provided by an IGS can be ingested into the USGS archive and processed to generate an L0Rp product of equivalent quality to the USGS-derived L0Rp product.
- Verifying that the L0Rp product resulting from the IGS RCC data can be ingested by USGS processing systems and processed to an L1G product, which is of equivalent quality to the USGS-derived L1G product.

An overview of the RCC data validation procedure is as follows:

- RCC subinterval data from the IGS are ingested for inventory processing and entry into the USGS archive (as validation data).
- Processing and subinterval metadata information from the IGS-derived data are compared to the corresponding USGS subinterval metadata information acquired from the Landsat 7 SSR.
- After the IGS-provided RCC data are ingested successfully, and the metadata are determined to be of equivalent quality, both the IGS- and USGS-derived data are processed to L0Rp.
- An image-to-image comparison is performed on the IGS- and USGS-derived L0Rp products (band 8 only).
- After the L0Rp data are determined to be of equivalent quality, both scenes are processed to L1G.
- The two L1G products are compared using image analysis tools available within the Image Assessment System (IAS), such as image-to-image correlation. Statistics are generated by the IAS to provide a basis for comparison.
- After the L1G products are determined to be of equivalent quality, the IGS data validation exercise is considered to be successful.

2.8.2 L0Rp Products

The objectives of the L0Rp data product validation procedures include:

- Verifying that the IGS L0Rp data are of equivalent quality to those generated by the USGS.
- Verifying conformance to the L0Rp DFCB (LS-DFCB-03) specifications, thus ensuring that L0Rp data provided by multiple stations will be readable using standard ingest routines.
- Verifying that the IGS L0Rp data can be ingested by USGS processing systems and processed to an L1G product of equivalent quality to the USGS-derived L1G product.

An overview of the L0Rp data validation procedure is as follows:

1. Processing and metadata file information from the IGS-provided L0Rp product are compared against the L7 L0Rp DFCB (LS-DFCB-03) and an equivalent USGS-derived L0Rp data product acquired from the Landsat 7 SSR.
2. The L0Rp data from the IGS are ingested into the IAS for processing and analysis.
3. An image-to-image comparison is performed on the IGS- and USGS-derived L0Rp products (band 8 only).
4. After the L0Rp data are determined to be of equivalent quality, both scenes are processed to L1G.
5. The two L1G products are compared using image analysis tools available within the IAS, such as image-to-image correlation. Statistics are generated by the IAS to provide a basis for product comparison.
6. After the two L1G products are determined to be of equivalent quality, the IGS data validation exercise is considered to be successful.

2.9 Documentation of Validation Results

The USGS will document the results of the L7 data quality validation to the IGS after each validation exercise. Validation results will also be distributed on a yearly basis to the Landsat Technical Working Group (LTWG) and Landsat Ground Station Operations Working Group (LGSOWG) participants.

2.10 Waiver of Validation Requirements

Once each individual IGS has been successfully validated, a waiver of the individual IGS validation requirement may be allowed for cases where the IC can demonstrate, by analysis and example, that the data from a single station is representative of the performance of all administered stations. This waiver allows the IC to potentially provide a single data set that can be used for validation of all the administered stations.

2.11 Data Validation by the IGS

Each IGS will receive one RCC validation data set with supplementary information from the USGS once per year. An L0Rp product corresponding to a single scene within the RCC data set may also be provided to the IGS, upon request by the IGS. Additional validation data sets may also be provided to the IGS upon request, with the approval of the Landsat Project Manager.

Each IGS will be responsible for creating and maintaining their own methods and procedures throughout their data validation exercise.

When USGS data are provided to an IGS for data validation purposes, the IGS is requested to provide a detailed summary of the data validation results to the USGS within 60 days after IGS receipt of the data.

Section 3 Key Government Programs

3.1 Definition

As described in the MOU, a key government program is one that requires L7 data for scientific research or emergency disaster relief applications. A key government program must be administered by a government agency or government organization.

Administration of a key government program consists of either a direct activity of a government agency or organization, a subcontracted activity directly managed by a government agency or organization, and/or an activity funded directly by a government agency or organization.

Data exchange for an IC key government program data request is limited to data currently archived in the USGS L7 archive and visible through the publicly accessible inventory and search system.

3.2 Authorization Requirements

3.2.1 USGS Authorization

The USGS Landsat Project Manager or designee authorizes key government programs to use the provisions of the MOU and certifies that the requesting program meets the criteria set forth in the Data Exchange Annex of the MOU for a key government program. This person is also responsible for tracking usage of this provision of the MOU to ensure data volume limitations are maintained.

The Landsat Project Manager serves as the final authority in resolving disputes regarding this application of the MOU.

3.2.2 IC Authorization

As specified in the MOU, the signatory to the MOU or designee serves as the certifying authority for IC requests for key government program status. All data requests for an IC key government program go through the MOU signatory or designee. This person serves as the single POC between requesting programs and the USGS Landsat Project and is responsible for tracking requests to ensure that the specified data volume limitations are maintained.

Under the terms of the MOU, the Landsat Project Manager can increase the number of scenes provided to an IC as part of a key government program.

3.3 Data Request Procedures

Under the terms specified in the MOU, the USGS is permitted to request up to 500 scenes per year from each IC. Each IC is allowed to request up to 500 scenes per year from the USGS L7 archive, visible through the publicly accessible search and order systems.

Each station, including the USGS, defines procedures for submitting data requests in support of key government programs. Provisions are made to place high-priority, rapid turnaround orders for emergency/disaster response activities.

The IC MOU signatory or designee acts as a single point of contact for requesting data from the USGS under this provision. The USGS Landsat MMO acts as a single point of contact for receiving and initiating fulfillment of any data requests from ICs using this provision.

3.4 Data Delivery Requirements

Data delivery requirements for IC government programs will be negotiated on a case-by-case basis to the mutual agreement of the IC, USGS, and key government program.

Turnaround time for delivery of standard L7 data requests will vary from 3 days to 3 weeks, depending on the level of processing required, media type, and method of delivery. Time-critical emergency and/or disaster response orders are to be handled through established User Services procedures and protocols for high-priority order submissions and acquisition requests.

3.5 Data Archive and Distribution Rights

As specified in the MOU, data provided to the IC as part of a key government program are subject to the prevailing data policy of the local station unless otherwise negotiated between the USGS, the key government program, and the IC. Data the USGS receives from an IC for key government programs are subject to the data policy of the USGS for archiving and distributing the data and subsequently produced data products

Section 4 Significant Loss of L7 Spacecraft Capability

4.1 Definition

Data exchange for loss of spacecraft capabilities is invoked in response to a temporary or sustained loss of spacecraft capability to record data to the SSR. The USGS MMO determines playback and/or downlinks recorded data to support multiple downlinks for emergency situations.

As defined in the MOU, this data exchange is one-way, from an IC to the USGS. Due to the uncertainties in evaluating spacecraft anomalies and the high priority associated with addressing spacecraft issues, the USGS may request data to be exchanged retroactively from a station's historical archive.

4.2 Authorization

The USGS MMO is the determining authority for implementing a data exchange based on a temporary or permanent loss of system capabilities. Permanent loss of the SSR as defined in the MOU may necessitate renegotiations of the MOU between the USGS and the IC regarding per-scene costs and/or station access fees.

4.3 Data Transfer Requirements and USGS Support

Data are requested on a subinterval (contact) basis, but accounted for on a scene-by-scene basis. Data are delivered in accordance with either the RCC and/or L0Rp DFCBs (LS-DFCB-01; LS-DFCB-03). Data transfers will be arranged individually with each IGS, based on the data format requested/generated and station capabilities.

The USGS may opt to provide specialized data-capture equipment to a site for data collection. Arrangements for installation and operation of this specialized data-capture equipment are negotiated between the USGS and the IC.

4.4 Data Delivery Requirements

Data delivery turnaround time will be 30 or fewer days, from the time a data request is submitted to an IC to the date of data delivery to the USGS.

4.5 Data Archive and Distribution Rights

As specified in the MOU, the USGS will archive, distribute, and generate products and re-distribute the exchanged data in accordance with U.S. Data Policy, unless otherwise negotiated between the USGS and the IC. The USGS will distribute IGS-acquired data to the public no earlier than 30 days from the date of acquisition, unless the requested data is for a key government program.

4.6 Data Format

Data shall adhere to the L7 RCC DFCB (LS-DFCB-01) or L0Rp DFCB (LS-DFCB-03). The RCC data are specified by contact/subinterval and/or spacecraft time index. The L0Rp products are specified by scene (path and row) and acquisition date.

Section 5 Short-term Loss of IC Reception Capability

One-way data transfers to an IC are authorized under the MOU to address problems or anticipated problems with L7 data reception, such as short-term loss of reception capability due to station outages caused by scheduled maintenance or hardware failures.

5.1 Authorization Requirements

5.1.1 USGS Authorization

The USGS Landsat Project Manager or designee gives authorization to use this provision of the MOU and determines if the requesting station meets the criteria set forth in the MOU for data exchange. This person is also responsible for tracking usage of this provision of the MOU to ensure data volume limitations are maintained.

The Landsat Project Manager serves as the final authority in resolving disputes in this application of the MOU.

5.1.2 IC Authorization

The signatory to the MOU or designee serves as the certifying authority for IC requests for data and tracking requests to ensure that the specified data volume limitations are maintained.

Under the terms of the MOU, the Landsat Project Manager can increase the number of scenes provided to an IC.

5.2 Data Availability

Each IC may request up to 300 scenes per year from the USGS L7 archive using the publicly accessible search and order systems. Scenes ordered are limited to those within the IGS station reception footprint(s), which have been acquired using the SSR during the time of a station outage. During a planned station outage, an IC may request that the USGS acquire additional coverage using the SSR to the extent that spacecraft resources are available.

5.3 Data Format

Data shall adhere to the L7 RCC or L0Rp DFCB. The RCC data are specified by contact/subinterval and/or spacecraft time index. The L0Rp products are specified by scene (path and row) and acquisition date.

Section 6 Funding Mechanisms

6.1 Product Validation

Data exchanged between the USGS and IC for data validation are provided without any exchange of funds or other compensation. The party generating the data is also responsible for funding shipment of the data to the requesting party.

6.2 Key Government Programs

Several payment mechanisms may be used based upon agreement between the USGS and the IC. They include quid pro quo, data in lieu of data access fees, or any method of payment agreed to by the parties. In general, the cost-of-reproduction (COR) model is used as a basis for calculating per-scene costs, or a price negotiated between the USGS and the IC.

6.2.1 Quid Pro Quo

Upon mutual agreement of the station and the USGS, data exchange costs may be handled on a quid pro quo basis, whereby an equivalent number of scenes or an equivalent amount of and type of data are exchanged between the station and the USGS. In this case, both the station and the USGS cover their respective costs associated with ordering, data production, and shipping between the station and a designated USGS representative.

6.2.2 Adjustments of the Data Access Fees

At the discretion of the Landsat Project Manager and upon mutual agreement of the station and the USGS, the equivalent value of provided scenes may be counted against the payment of data access fees.

6.3 Significant Loss of L7 Spacecraft Capability

For temporary losses of spacecraft capability, the USGS may request data from the IC and pay for such data by reducing the value of the exchanged data from the data access fees.

For a permanent loss of spacecraft capability, in which the USGS becomes dependent upon IC-operated ground stations to populate the USGS archive, the USGS may renegotiate the Cost-sharing Annex of the MOU.

6.4 Short-term Loss of IC Reception Capability

Several payment mechanisms may be used based upon agreement between the USGS and the IC. They include quid pro quo, adjustments to data access fees, or any other method of payment agreed to by the parties.

6.4.1 Quid Pro Quo

Upon mutual agreement of the station and the USGS, data exchange costs may be handled on a quid pro quo basis, whereby an equivalent number of scenes are exchanged between the station and the USGS. In this case, both the station and the

USGS cover their respective costs associated with ordering, data production, and shipping between the station and a designated USGS representative.

6.4.2 Adjustments to Data Access Fees

At the discretion of the Landsat Project Manager and upon mutual agreement of the station and the USGS, the equivalent value of the requested scenes may be added to the schedule of data access fees. In general, the standard USGS pricing model is used as a basis for calculating per-scene costs.

Section 7 Plan Implementation

7.1 Effective Date

The terms, conditions, and procedures of this plan are in effect at the time that the signatory of the MOU signs the Data Exchange Annex.

7.2 Data Validation Schedule

The activities of validating the readability of IGS data are ongoing and will be conducted twice per year. Each IGS will also receive validation data once per year to validate L7 data from the USGS.

7.3 Contingency Plan for Loss of Landsat Spacecraft Capability

USGS maintains a detailed Contingency Plan to address the technical and programmatic issues involved in collaborating with IC to acquire L7 data to populate the USGS archive.

References

Please see http://landsat.usgs.gov/resources/acronyms.php for a list of acronyms.

USGS/EROS. Landsat 7 System Data Format Control Book (DFCB), Volume IV: Wideband Data. Revision L. June 1999.

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Memorandum of Understanding Between the U.S. Geological Survey of the Department of the Interior and the International Cooperator for the Direct Reception and Distribution of Landsat 7 Data, and the draft Annex III for Data Exchange.